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GB 1314181 A GB 1032742 A EP 0250801 A1
US 4728426 A US 3747772 A

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(54) Filter Element

(57) A filter element (10) comprises two corrugated layers (11, 12) of fusible filter media arranged superimposed to define elongate air flow passages therebetween, and between said corrugated layers an internal support structure (15) which extends across a substantial part of the width of the element and along a substantial part of the length of the element to seperate at least a part of one corrugated layer from direct contact with the other layer, the layers (11, 12) of fusible filter media being fused relative to one another for example by ultra sonic welding to provide a structural interconnection which inhibits separation of said layers when the pressure in the passages (23) exceeds the external pressure.

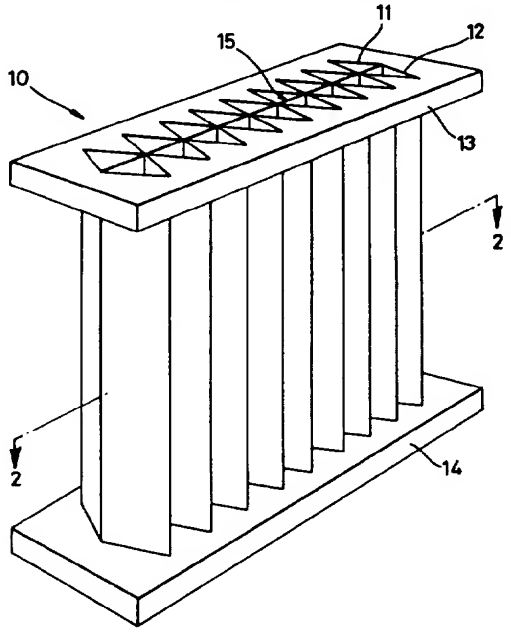

Fig. 1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

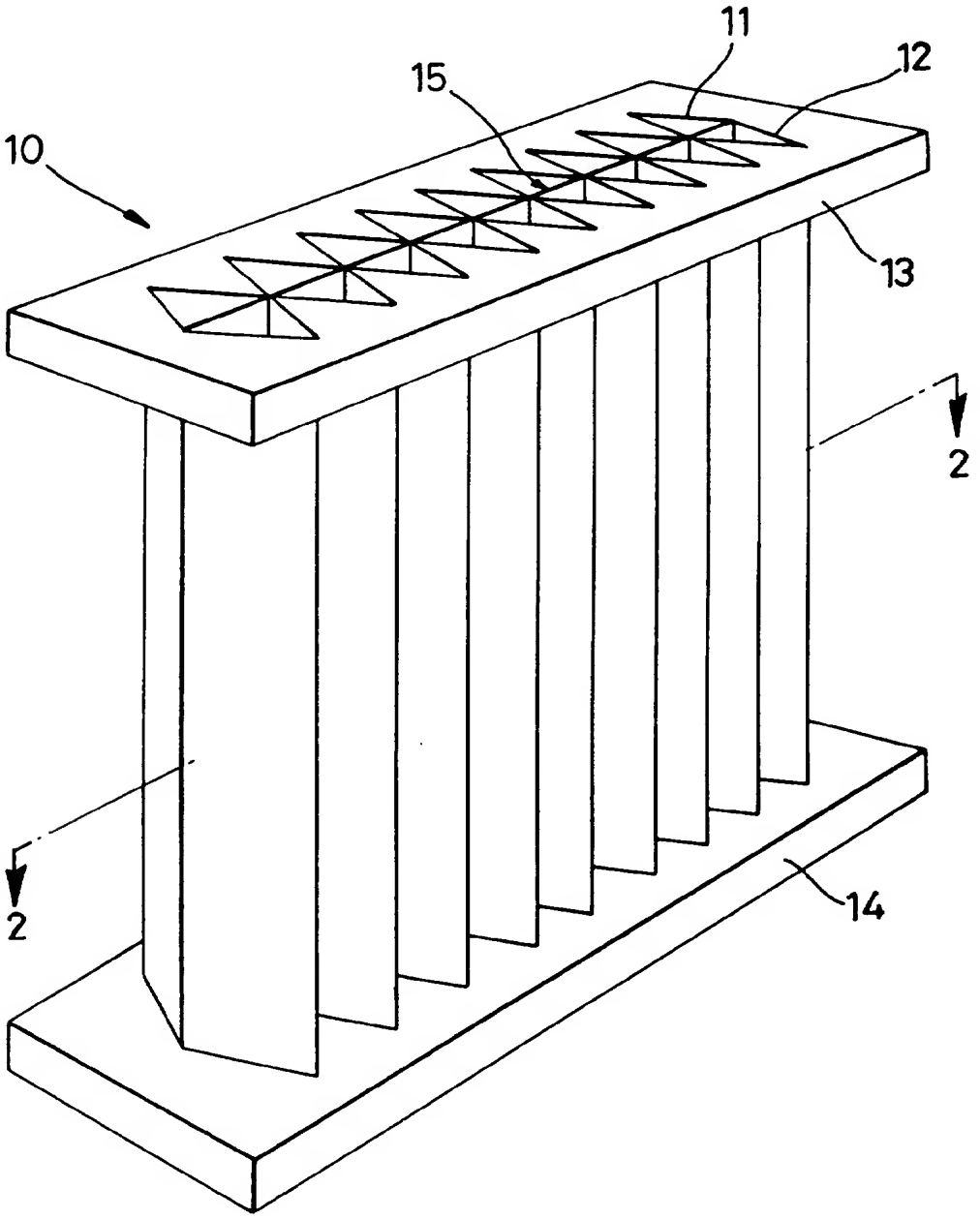

Fig. 1

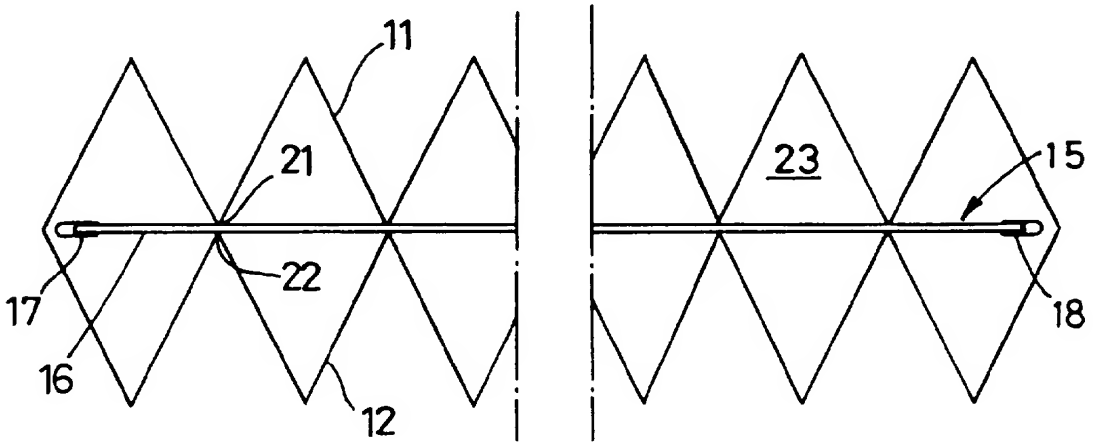

Fig. 2

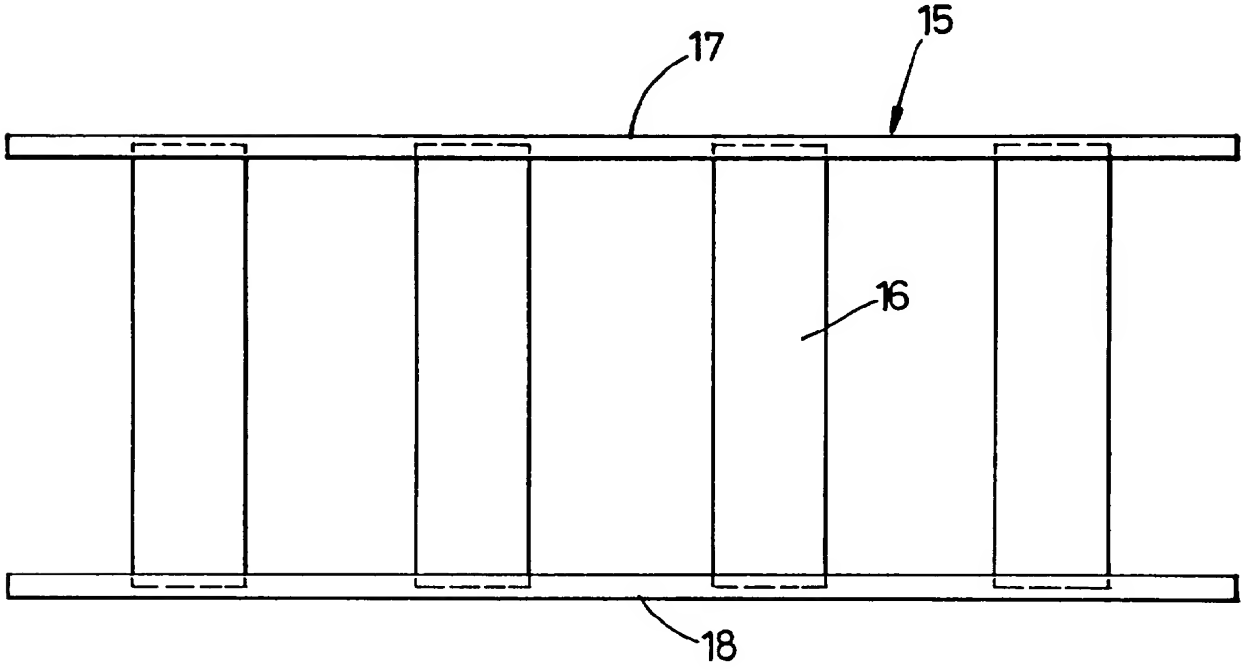

Fig. 3

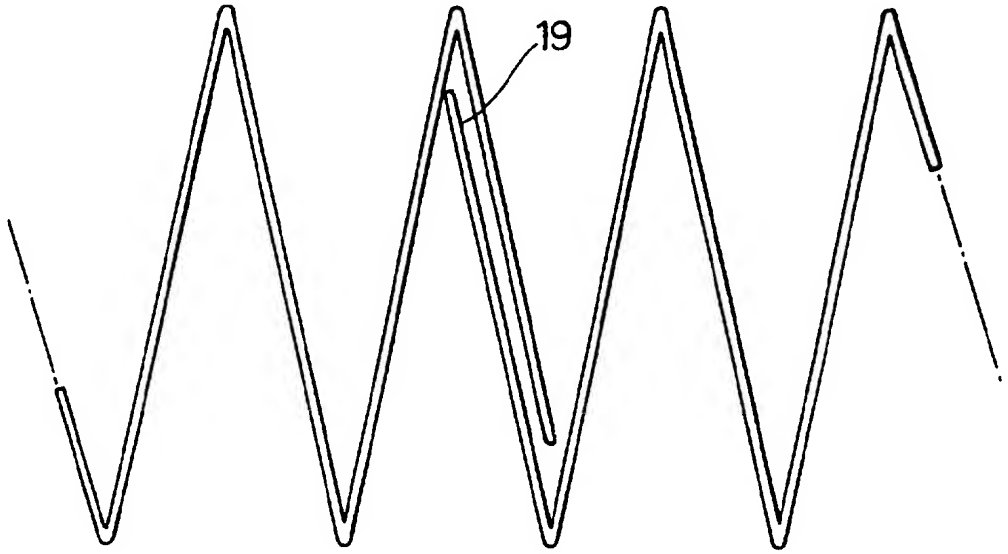

Fig. 4

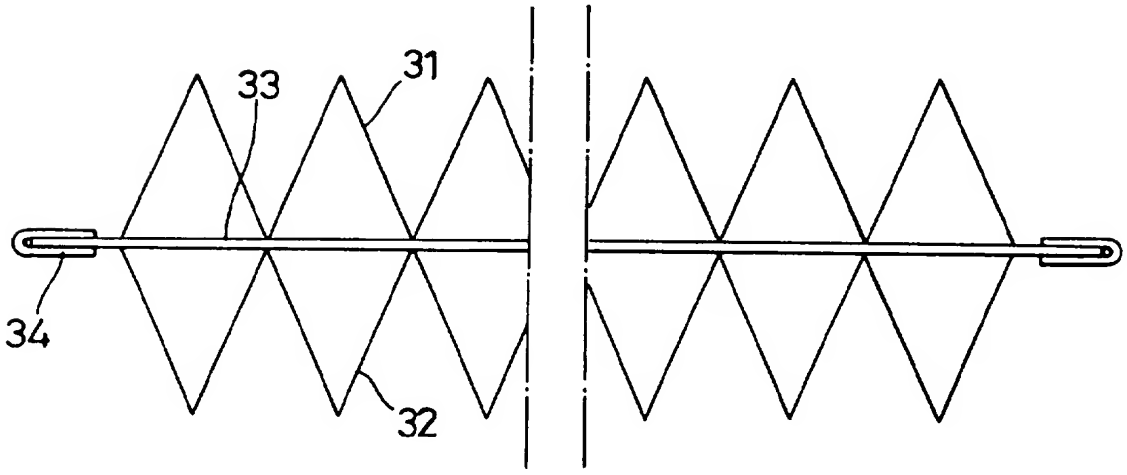

Fig. 5

FILTER ELEMENT

This invention relates to a filter element and an assembly of a plurality of filter elements generally and in particular, though not exclusively, to a filter element and filter element assembly for use in an industrial type filter unit of the kind provided with means for intermittent cleaning or regeneration of a filter element. The invention is particularly applicable to a filter element of a corrugated or so-called pleated type.

A pleated type filter element typically comprises a layer of filter media which has been passed through a pleating machine to produce a pleated web of a predetermined corrugated cross-sectional shape. The filter media may be treated to render it substantially rigid or sufficiently semi-rigid so as to resist deformation and retain the pleated profile despite pressure differential forces which arise when the media is acting as a filter.

Usually two layers of pleated material are arranged in contact with one another and superimposed so that alternate fold regions of one layer lie in contact with or near to respective alternate fold regions of the other layer. In consequence the two layers define a plurality of parallel, internal passages through which filtered fluid, typically air or other gas, can flow to an end region of the filter element.

The ends of two layers may be held in moulded end supports which restrain relative transverse movement of the folds. Thus the folds of the respective layers are maintained aligned and fixed to resist any tendency for nesting together of the layers and effective collapse of the internal passages. Therefore it is not necessary to provide the filter element with an internal support frame of the kind commonly used in a fabric bag filter and comprising a pair of spaced apart layers of support mesh.

Cleaning of the filter elements is achieved in a so-called "regenerative" manner by intermittent internal pressurisation to cause a momentary reversal of flow and consequent dislodgement of an accumulated dust cake. To prevent undue deformation of and damage to the pleated layers during reverse pressurisation use may be made of pleated layers which have a sufficiently great rigidity.

Attainment of that rigidity often necessitates provision of elements made from filter media which is heavier and more expensive than otherwise would be necessary.

Alternatively pleated layers may be bonded together by aligning the folds of confronting layers and using adhesive, pre-applied along the length of each confronting fold, to join the layers.

The need to align and bond every touching pleat can, however, add to assembly costs.

The present invention seeks to provide an improved filter element and an assembly in which the problems of known techniques for withstanding reverse pressurisation are mitigated or overcome.

In one of its aspects the present invention provides a filter element comprising a pair of corrugated layers of fusible filter media arranged superimposed to define at least one internal passage for flow of fluid therethrough, and within said at least one internal passage an internal support structure which extends across a substantial part of the width of the element and along a substantial part of the length of the element and serves to separate at least a part of one corrugated layer from direct contact with the other layer, wherein the layers of fusible filter media are fused relative to one another at least at intervals over the whole of the respective confronting surfaces of the pair of corrugated layers so as to provide a structural interconnection which inhibits separation of the two layers when the pressure within the element exceeds the external pressure.

The internal support structure may extend across the full width of the filter element or across only part of that width. Preferably it extends across at least 70% of the width of the element. One or both edges defining the width of the internal support structure may be sandwiched between or fixed to a pair of edge regions of the two layers of filter media.

The internal support structure may, for example, be formed from a metallic material such as aluminium or mild steel or a plastics material which may be a fusible plastics material such as polyethylene. The material of the support structure may be a perforated, i e apertured type of material.

The internal support structure, at least where it separates layers of filter media, and the layers of filter media, may be of the same fusible material.

The internal support structure may comprise substantially only a single sheet of material or may comprise a plurality of strips of material arranged spaced apart. In the latter case the strips preferably extend transversely or obliquely relative to the direction of the length of the internal passage(s) of the filter element. Spaced apart strips may be located in a preferred relative orientation prior to assembly with the layers of filter media, for example, by means of one or more edge members. The edge members may provide in part a frame within which the strips are secured. The strips of material may extend fully across the width of the element and be secured to respective opposite regions of a frame.

If the internal support structure comprises a plurality of strips, preferably those strips have a total width, measured along the length of the element, which is less than 60%, preferably less than 40%, of the length of the element. The strips may total less than 20% of the length of the element and may comprise in the order of 10% of said length.

The fused structural interconnection may be achieved directly between the layers of filter media at positions where they are not separated by the insert, or directly through perforations in the insert. The insert may be of fusible material and additionally or alternatively may be fused to each of the layers of filter media.

The structural interconnection of the fusible material may be achieved by an ultrasonic welding or other type of heat fusing technique.

The corrugated layers of filter media may be shaped to define therebetween a plurality of elongate passages for flow of air or other fluid. The layers may be corrugated to have a pleated zig-zag type shape in transverse cross-section or, for example, a corrugated curved, e g sinusoidal shape.

The filter element preferably is of a type having an aspect ratio greater than 1.0, more preferably greater than 1.5 wherein said aspect ratio

is the ratio of the length of the element in the direction of the length of said internal passage(s) to the width in a relative transverse direction.

Alternate folds of one layer, i e those nearest the other layer, may be aligned with respective alternate folds of that other layer so as to define a plurality of discrete, i e separate, elongate fluid flow passages.

Alternatively, the alternate folds of one layer which are nearest the other layer may lie off-set relative to folds of that other layer. In that case the internal support structure will serve to prevent the two corrugated layers nesting one within the other as well as inhibiting their separation.

Suitable materials for the corrugated layers include flexible air-permeable fibre fabrics. Such fabrics may be or be rendered substantially rigid or semi-rigid to resist undue deformation when subject in use to a pressure differential as air flows through the corrugated layers to within the element. Other suitable materials include rigidised paper, e g resin impregnated paper, and polyester. The corrugated layers may comprise randomly arranged fibres or filaments. The invention may be applied also to filter elements constructed from a relatively rigid filter media such as point bonded polyester and a brittle type material such as resin impregnated paper. The structural interconnection of the fusible material may serve to reinforce the filament element whereby it is better able to resist damage. It will also allow thinner, lighter and cheaper materials to be used.

The filter media may be of a kind having a capacity to collect at least 2.0 and preferably at least 3.5 mg/m^3 but may be a significantly higher collection of particulate matter from an air flow, e g at least 10.0 mg/m^3. Preferably it allows an air flow rate, during normal usage, of at least 0.1 $m^3/min/m^2$, more preferably at least 0.5 $m^3/min/m^2$.

A filter element of the invention may be generally planar, or of e g a circular or spiral form as shown in United Kingdom Patent Publication GB-A-2220588.

The invention contemplates that the filter element may be self supporting against expansion in a transverse, width direction perpendicular to an internal passage. It does not need to rely on external structure to

restrain any such tendency for expansion e g under reverse pressurisation.

The corrugated layers may be electrically conductive. This may be achieved by using a material which is inherently conductive due to the manner in which it is manufactured or by applying a surface coating/impregnation of carbon or similar material. A longitudinal edge or other region of a conductive filter element may be provided with a strip of conductive material, e g a metal strip, for electrical contact with a part of the filter housing thereby to allow, e g static charge to be conducted from the filter element to the housing and its earth connection.

The invention provides also a filter element assembly comprising at least one filter element of the invention mounted in a housing and arranged for dust laden air to impinge on external surfaces of the element. The assembly may comprise air supply means for intermittent internal pressurisation of an element for the purpose of regenerative cleaning.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of a filter element of the invention;

Figure 2 is a section on line 2-2 of Figure 1;

Figure 3 is a plan view of an internal part of the element of Figures 1 and 2;

Figure 4 is a detail of part of Figure 2, and

Figure 5 is a section corresponding to that of Figure 2 but for another filter element of the invention.

A flat type filter element 10 for filtration of dust laden air comprises two superimposed corrugated layers 11,12 of pleated filter media. The ends of the corrugations are embedded in moulded plastics open header and closed tail end sections 13,14.

The corrugated layers are formed by passing fusible spun bonded polyester through a pleating machine to produce a pleated structure of zig-zag shape in cross-section (Figure 2). A chosen length of pleated material is then folded so as to form the two superimposed layers 11,12 with edges of the material being overlapped in the form of a half pleat overlap 19

(Figure 4) at which the edges are sealed together.

The two corrugated layers 11,12 are spaced by an interposed insert 15. The insert 15 comprises a series of strips 16 (see Figure 3) of perforated (i e apertured) steel which are held spaced apart by two U-section edge channels 17,18 held crimped to the ends of the perforated strips. The width and spacing of the strips 16 is selected such that the total width of the strips is less than 12½% of the length of the insert, which in this embodiment is the length of the U-section channels 17,18.

The width of the insert 15 (i e length of the strips 16) is slightly less than the width of the filter element so that the insert can fit within the internal width of the element (see Figure 2).

In manufacture of the element the pair of corrugated layers are formed with an overlap joint as aforedescribed, the insert 15 is inserted between the corrugated layers and the header and tail sections 13,14 are then moulded in conventional manner.

Subsequently the filter media is subject to ultrasonic welding so as to fuse together the folds of the two layers of filter media where they confront one another between the insert strips 16. The resulting fused interconnection provides a structural interconnection that resists any tendency for the confronting aligned folds 21,22 of the two corrugated layers to separate under reverse jet pressurisation.

In the resulting construction of the filter element 10 the insert 15 acts in combination with the end sections 13,14 to resist relative transverse movement of the two corrugated layers. It also resists any tendency for the layers to nest one in the other during normal use in which contaminated air flows through and is filtered by the layers due to a pressure differential in which the space within the element is less than that external thereof.

During reverse air jet cleaning the insert 15 assists in helping to achieve a substantially uniform dispersion of air and thus promotes a substantially uniform cleaning action.

The invention will now be described as applied to another pleated filter 30 (see Figure 5). This is formed from two separate layers 31,32 of

pleated filter media which are laid one on top of the other in a sandwich arrangement in which an insert 33 of fusible polyester is positioned between the layers. The insert extends the full width of the corrugated layers and at each edge of the part-formed element the edges of the two layers and the insert are gripped together by an external metal channel 34 of U-shape in section. That part-assembly is then provided with moulded head and tail sections as aforedescribed. Ultrasonic welding results in folds of each layer of filter media 31,32 being fused to the insert thereby to provide indirectly a structural interconnection of the layers.

The pleated layers may each have a surface coating/impregnation of carbon laden material which is in electrical contact with the metal edge strips. In use the filter element is fitted in a housing having spring loaded metal contacts which bear firmly against the metal edge strips. By connecting the filter housing to earth any static electricity is safely discharged from the element via its coating and the metal edge strips.

CLAIMS:

1. A filter element comprising a pair of corrugated layers of fusible filter media arranged superimposed to define at least one internal passage for flow of fluid therethrough, and within said at least one internal passage an internal support structure which extends across a substantial part of the width of the element and along a substantial part of the length of the element and serves to separate at least a part of one corrugated layer from direct contact with the other layer, wherein the layers of fusible filter media are fused relative to one another at least at intervals over the whole of the respective confronting surfaces of the pair of corrugated layers so as to provide a structural interconnection which inhibits separation of the two layers when the pressure within the element exceeds the external pressure.

2. A filter element in accordance with claim 1 wherein the layers of fusible filter material are fused directly to one another at positions where they are not separated by the internal support structure.

3. A filter element in accordance with claim 1 or claim 2 wherein the internal support structure comprises perforate type material.

4. A filter element in accordance with claim 3 wherein the layers of fusible filter media are fused directly to one another through said perforations.

5. A filter element in accordance with any one of the preceding claims wherein the layers of fusible filter media are fused to the internal support structure.

6. A filter element in accordance with any one of the preceding claims wherein the internal support structure comprises fusible material.

7. A filter element in accordance with claim 6 wherein said fusible material is a fusible plastics material.

8. A filter element in accordance with claim 7 wherein said fusible material is a thermoplastics material.

9. A filter element in accordance with claim 7 or claim 8 wherein said plastics material is a polyethylene.

10. A filter element in accordance with any one of the preceding claims

wherein the layers of fusible filter media have been structurally interconnected relative to one another by a heat fusing technique which comprises the application of heat.

11. A filter element in accordance with any one of claims 1 to 9 wherein the layers of fusible filter media have been structurally interconnected relative to one another by ultrasonic welding.

12. A filter element in accordance with any one of the preceding claims wherein the internal support structure comprises a plurality of strips of material arranged spaced apart and each extending transversely or obliquely relative to the direction of the length of the internal passage(s) of the filter element.

13. A filter element in accordance with claim 12 wherein the strips are secured to at least one edge member which, at least prior to assembly of the strips with the layers of filter media, serves to locate said strips in a preferred relative orientation.

14. A filter element in accordance with claim 12 or claim 13 wherein the plurality of strips have a total width, measured along the length of the element, which is less than 60% of the length of the element.

15. A filter element in accordance with claim 14 wherein said total width of the strips is less than 40% of the length of the element.

16. A filter element in accordance with claim 15 wherein said total width of the strips is less than 20% of the length of the element.

17. A filter element in accordance with any one of the preceding claims wherein alternate folds of one layer of filter media are aligned with respective alternate folds of the other layer of filter media to provide a plurality of discrete elongate fluid flow passages.

18. A filter element in accordance with any one of the preceding claims wherein the internal support structure extends across at least 70% of the width of the element.

19. A filter element according to claim 18 wherein the internal support structure comprises strips which extend fully across the width of the element and are secured to respective opposite regions of a frame.

20. A filter element in accordance with any one of the preceding claims wherein the corrugated layers of fusible filter media comprise flexible air permeable fabric rendered substantially rigid or semi-rigid.

21. A filter element according to any one of the preceding claims wherein the ratio of the length of the element in a direction of the length of an internal passage to the width in a relative transverse direction is at least 1.0.

22. A filter element according to claim 20 wherein said ratio is at least 1.5.

23. A filter element according to any one of the preceding claims wherein the corrugated layers comprise randomly arranged fibres or filaments.

24. A filter element according to any one of the preceding claims wherein the filter media has a capacity to collect at least 2 mg/m^3 of particulate matter from the air flow.

25. A filter element in accordance with claim 1 and substantially as described with reference to and as shown in the drawings.

26. A filter assembly comprising a housing and a filter element according to any one of the preceding claims mounted in said housing and arranged for dust laden air to impinge on external surfaces of the element.

27. A filter assembly according to claim 26 and comprising air supply means for intermittent internal pressurisation of the filter element for regenerative cleaning of said element.

28. A filter assembly according to claim 26 and substantially as described with reference to and as shown in the drawings.

The Patent Office

Application No: GB 9522419.2
Claims searched: 1-28

Examiner: Dr. A.J.Rudge
Date of search: 1 February 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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B1D(DBGA,DBHA,DBXA,DBHX,DDAA,DDGA,DDJA,DDNA,DEXA)

Int Cl (Ed.6): B01D-027/06;27/07;27/14;29/50

Other: ONLINE DATABASES:WPI,CLAIMS,EDOC,WPIL

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 1314181	(Marshall)	
A	GB 1032742	(Ozonair)	
A	EP 0250801A1	(Allied Corporation)	
A	US 4728426	(Kernforschungszentrum)	
A	US 3747772	(Parker-Hannifin)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.